

# **Mars Pathfinder Project**

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## **Lander Imager for Mars Pathfinder (IMP) Experiment Data Record (EDR)**

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### **JPL**

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## ACRONYMS AND ABBREVIATIONS

CAHV	Camera model described by four vectors C, A, H and V
CAHVOR	Camera model CAHV with CCD and non-linear distortions accounted
CCD	Charge-Coupled Device
EDR	Experiment Data Record
IMP	Imager for Mars Pathfinder
JPEG	Joint Photographic Experts Group
MIPS	Multimission Image Processing Subsystem
PDS	Planetary Data System
TBD	To Be Determined
VICAR	Video Image Communication and Retrieval system

## ACTION ITEMS FOR CLOSURE

Item	Pages	Assignee	Closure Date
IMP Calibration Report publication date	1	C. Shinohara	October 1995
Calibration header fields	all	A. Runkle	May 1996
Error packet file specification	all	A. Runkle	May 1996

## 1.0 INTRODUCTION

This specification describes the image data products to be delivered to the Lander Imager for Mars Pathfinder (IMP) Team of the Mars Pathfinder Project by the Multimission Image Processing Subsystem (MIPS). The specifications of the software that produce the products described herein are beyond the scope of this document. Applicable documents used in producing this specification include:

- 1) Planetary Data System Standards Reference, JPL D-7669, Part 2.
- 2) Planetary Science Data Dictionary Document, JPL D-7116.
- 3) IMP Flight Software Telemetry Format, University of Arizona, January 1995.
- 4) VICAR File Format, JPL, R. Deen, Interoffice Memorandum 384-92-196, September 1992.
- 5) IMP Calibration Report, University of Arizona, TBD.
- 6) DISRSOFT Image Processing Document, N. Thomas, J. Stüwe, Max-Planck Institute for Aeronomie, Version 1.5, July 12, 1994.
- 7) Mars Pathfinder AIM Phasing and Coordinate Frame Document, JPL D-12103, PF-300-4.0-04.
- 8) IMP Flight Software Command Format, University of Arizona, January 1995.

### 1.1 Product and Transferal Mechanism

The image data files and labels generated by MIPS software for Mars Pathfinder will be transferred electronically to the IMP Team with automatic electronic notification. Each image file will be generated in IMPSOFT header and file format. A separate, detached Planetary Data System (PDS) label file will be associated with each image file, but not delivered to the IMP Team. The image data files may be generated on any one of the following platforms: Sun Sparcstations running Solaris, Sun Sparcstation running SunOS, Silicon Graphics running IRIX.

### 1.2 Image Data Processing

The data packaged in the files will be decoded, decompressed IMP image data in single frame form as an Experiment Data Record (EDR) and optionally in mosaic form. The single frame form of a standard image data set has maximum dimensions 256 lines by 256 samples. The other data sets and their image sizes are listed in Table 1. Single image frames can be mosaicked to produce a larger image. The VICAR software used to generate the image data set products are described in Table 2.

Table 1. — Maximum data set size for Mars Pathfinder IMP Image Data Files

Image Type	Image Size lines x samples	Pixel Size (bits)	Description
Image Data	256 x 256	16	Image data is unsigned and rotated from the way it is generated in the camera. Left images are rotated counter-clockwise, right images are rotated clockwise.
Dark Strip	256 x 8	16	
Null Strip	256 x 8	16	

Table 1. — *Maximum data set size for Mars Pathfinder IMP Image Data Files - Cont'd*

Image Type	Image Size lines x samples	Pixel Size (bits)	Description
Flat Field	256 x 256	16	Flat Field data is unsigned and rotated from the way it is generated in the camera. Left images are rotated counter-clockwise, right images are rotated clockwise.
Dark Field	256 x 256	16	Dark Field data is unsigned and rotated from the way it is generated in the camera. Left images are rotated counter-clockwise, right images are rotated clockwise.
Histogram	1 x 4096	16	Histogram data contains a 4096 element histogram table where each sample corresponds to the count of Dn values in the target image.
Summed	2 x 256	32	All rows and columns are summed. The first record is the result of the row/column summing where each sample corresponds to the a row/column sum. The second record is the result of column/row summing.

### 1.3 Coordinate System Components

The following paragraphs discuss the various types of coordinate system components, describing in more detail those supported by this project.

#### 1.3.1 Coordinate Frames

There are six different coordinate systems referenced in the MPF AIM Phasing Document (reference 7). The following four coordinate frames are supported by MIPS and identify pointing and location of the image data.

##### 1.3.1.1 Lander Frame

The Lander frame, identified as the L Frame, is a coordinate system that is fixed to the geometry of the lander. Most of the pointing information identified in the IMP EDR label items reference this coordinate system.

NOTE: For the purpose of pointing, the Lander and IMP Frames are identical.

##### 1.3.1.2 IMP Frame

The IMP frame is oriented such that all of the axis are colinear to the Lander Frame. The origin of the IMP Frame is offset from the Lander frame (See the MPF AIM Phasing document for the correct offset distances). For the purposes of pointing, the IMP and Lander frame are identical.

NOTE: For the purpose of pointing, the Lander and IMP Frames are identical.

#### **1.3.1.3 Local Level Frame**

The Local Level frame, identified as the M Frame, shares the same origin as the Lander Frame. The orientation of the coordinate frame is defined relative to the Mars areocentric coordinate system.

NOTE: For the purpose of pointing, the Local Level and Mars Surface Fixed Frames are identical.

#### **1.3.1.4 Mars Surface Fixed Frame**

The Mars Surface Fixed frame, identified as MFX Frame, is oriented such that all of the axis are colinear to the Local Level Frame. Originally the origin of the MFX is identical to the M Frame, but can be offset due to pedal movement, air-bag settling or other translational effects.

NOTE: For the purpose of pointing, the Local Level and Mars Surface Fixed Frames are identical.

#### **1.3.2 Areocentric**

Center normal coordinate system

#### **1.3.3 Areodetic**

Surface normal coordinate system

#### **1.3.4 Quaternion**

Defines this in MPF usage



## 2.0 DETAILED SPECIFICATION

The following section describes in greater detail the files to be received by the IMP Team.

### 2.1 Structure and Organization Overview

For each archived IMP image, one file is created, an image data file with an internal PDS label. This file constitutes a set of data to be managed and archived by MIPS as one unit.

#### 2.1.1 MIPS Local Image File

An image file consists of two major parts: the image header, which describes what the file is, and the image area, which contains the actual image data. The image header and image area are stored as a standard VICAR image. The file format conversion available to the IMP team will be IMP\_Soft and PDS. Ancillary data for the PDS labels are described in section 2.1.2.

Table 2. — VICAR Software for Mars Pathfinder IMP Image Data Files

Application	Description
MPFTELEMPROC	Fetches the image Standard Formatted Data Unit (SFUD) records from the Telemetry Delivery Subsystem (TDS), and reconstructs the image file from the telemetry data. If a version of this image exists in the Working Mission Storage (WMS), the image data is compared the WMS version. If the new version has more data than the existing version, it replaces the WMS version. This application produces a VICAR image file with a subset of descriptive label items. It also accesses the catalog and SPICE kernels to supplement the ancillary image information from the telemetry data.
MPFCAHV	Converts uncorrected images to a corrected CAHV camera model.
MPFMAP	Produces polar coordinate mosaics (azimuth versus elevation) from uncorrected input images using a CAHVOR camera model. This application updates the label of the image file.
MPFMOS	Produces pinhole camera mosaics using uncorrected input images and a CAHVOR camera model. This application updates the label of the image file.
MPFNAV	Updates azimuth and elevation based on comparison with an existing known image data set that can be directly compared.

The image data will be a single image frame captured by the IMP camera (EDR). The nominal image frame size is 248 lines by 256 samples. The primary image data format is unsigned integers (halfword) for 12-bit image data.

#### 2.1.2 PDS Archived Label File

Every archived image data file contains a PDS label. This label conforms to the Planetary Data System standard for ancillary data management. The label contains information regarding the observation which produced the image. This observation information includes general descriptors such as target and time tags of the start of image acquisition, camera and spacecraft state parameters, data compression information, viewing and lighting geometry, spacecraft position and camera pointing, image dimensions, and processing history. This PDS labeled image is the IMP Team defined standard for transferring data between home institutes.

The PDS label is an object-oriented file; the object to which the label refers is denoted by a statement of the form:

$$^{\text{object}} = \text{location}$$

in which the carat character '^' (also called a pointer in this context) indicates that the object starts at the given location. In a detached label, the location denotes the name of the file containing the object, along with the starting record or byte number, if there is more than one object. For example:

$$^{\text{IMAGE}} = (\text{"i392301.img"}, 3)$$

indicates that the IMAGE object begins at record 3 of the file i392301.img.

All labels contain 80-byte fixed-length records, with a carriage return character (ASCII 13) in the 79th byte and a line feed character (ASCII 10) in the 80th byte. This allows the files to be read by the HFS, MacOS, DOS, OS2, Unix, and VMS operating systems.

The following is a template of the IMP EDR PDS label. See Appendix A for detailed definitions and formatting information for the label items. Also, note that label item values which are capitalized or those values enclosed in quotes but not italicized represent label item values to be written verbatim. Where and entire line is italicized, this represents label item/value pairs which occur only for image mosaic products or calibration files, as noted in the leading label comments.

Text inside broken brackets, '<' and '>', identify the type of data that is valid for a label value.

Figure A. — Template of Mars Pathfinder IMP EDR PDS Label File

```

/* File Format and Length */
PDS_VERSION_ID          = PDS3
RECORD_TYPE              = FIXED_LENGTH
RECORD_BYTES             = 80
FILE_RECORDS             = number of label records in the file

/* Pointers to Start Records of Objects in File */
^IMAGE                   = ("i<scikstrcnt>.<file extension>",
                           <# of VICAR label records>)

/* Image Description */
MISSION_NAME             = "MARS PATHFINDER"
SPACECRAFT_NAME          = "PATHFINDER LANDER"
INSTRUMENT_NAME          = "Imager for Mars Pathfinder (IMP)"
TARGET_NAME              = planetary body, feature or region

IMAGE_ID                 = nnnnnnnnnn
FRAME_ID                 = <FRAME_LEFT, FRAME_RIGHT, FRAME_BOTH,
                           FRAME_LEFT_HALF>
IMP_FRAME_ORIGIN          = (ff.fff, ff.fff, ff.fff)
RECEIVED_PACKETS         = nnn
EXPECTED_PACKETS         = nnn
MAXIMUM                  = nnnn
MEAN                      = ffff.fff
MEDIAN                   = nnnn

```

Figure A. — Template of Mars Pathfinder IMP EDR PDS Label File (continued)

```

MINIMUM                      = nnnn
STANDARD_DEVIATION           = fff.fff
DATA_SET_NAME                 = "Mars Pathfinder Mars Imager for Mars Pathfinder 2 EDR Vx.x"
DATA_SET_ID                   = "MPF-M-IMP-2-EDR-V1.0"
PRODUCT_ID                    = "IMP_EDR-<selkstrcnt>-<image_observation_type>-<image_id>"
PRODUCT_CREATION_TIME         = yyyy-mm-ddThh:mm:ss.fff
PRODUCER_ID                   = "LPL/MIPS"
PRODUCER_FULL_NAME            = "Dr. Peter Smith, Lander IMP Team, and MIPS of JPL"
PRODUCER_INSTITUTION_NAME     = "Lunar and Planetary Laboratory, University of Arizona in
                                concert with MIPS of Jet Propulsion Laboratory (JPL)"
SOURCE_PRODUCT_ID             = {<SPK file name>, <PCK file name>, <EK file name>, etc.}
SOFTWARE_VERSION_ID           = "Version of MPF telemetry processing software"
PROCESSING_HISTORY_TEXT       = "Listing of processing steps to produce this image."

/* Time tags and observation descriptors */
APPLICATION_PACKET_ID         = nn
APID_DESCRIPTION              = "string describing the purpose of observation"
IMAGE_OBSERVATION_TYPE        = "string describing the type of observation"
IMAGE_TIME                    = yyyy-mm-ddThh:mm:ss.fff
SPACECRAFT_CLOCK_START_COUNT  = nnnnnnn
LOCAL_TIME                    = hh:mm:ss.fff
EXPOSURE_DURATION             = fff.fff

/* Camera and spacecraft state parameters */
FILTER_NAME                   = <filter name>
FILTER_NUMBER                  = nn
INSTRUMENT_TEMPERATURE         = <array of 2 floating point numbers>

/* Lighting geometry */
SOLAR_AZIMUTH                  = fff.fff
SOLAR_ELEVATION                = ±ff.fff

/* Spacecraft position and surface normal measure */
SPACECRAFT_LATITUDE            = ±ff.fff
SPACECRAFT_LONGITUDE           = fff.fff
SURFACE_NORMAL_AZIMUTH         = fff.fff
SURFACE_NORMAL_ELEVATION       = ±ff.fff

/* Camera model information */
CAMERA_ORIENTATION_QUATERNION = <array of 4 floating point numbers>
FOCAL_CENTER_VECTOR            = <array of 3 floating point numbers>
POINTING_DIRECTION_VECTOR      = <array of 3 floating point numbers>
HORIZONTAL_IMAGE_PLANE_VECTOR  = <array of 3 floating point numbers>
VERTICAL_IMAGE_PLANE_VECTOR    = <array of 3 floating point numbers>
MLL_MFX_OFFSET_VECTOR         = <array of 3 floating point numbers>
MLL_MFX_OFFSET_ERROR           = <array of 3 floating point numbers>

```

Figure A. — Template of Mars Pathfinder IMP EDR PDS Label File (continued)

```

AZIMUTH                      = fff.fff
AZIMUTH_ERROR                = fff.fff
AZIMUTHAL_FOV                = fff.fff
AZIMUTHAL_MOTOR_CLICKS      = nnnn

ELEVATION                    = ±ff.fff
ELEVATION_ERROR              = ff.fff
ELEVATIONAL_FOV              = fff.fff
ELEVATIONAL_MOTOR_CLICKS    = nnnn

SURFACE_BASED_CAMERA_AZIMUTH = fff.fff
SURFACE_BASED_CAMERA_AZIMUTH_ERROR = fff.fff
SURFACE_BASED_CAMERA_ELEVATION = ±ff.fff
SURFACE_BASED_CAMERA_ELEVATION ERROR = ff.fff

PIXEL_HEIGHT                 = fff.fff
PIXEL_WIDTH                  = fff.fff

/* IMP flight software commands */

TLM_CMD_DISCREPANCY_FLAG    = <TRUE or FALSE>

EXPOSURE_TYPE                = <AUTO, MANUAL, PRETIMED or NONE >
EXPOSURE_COUNT               = nn
AUTO_EXPOSURE_PIXEL_FRACTION = <fff.fff for AUTO only>
AUTO_EXPOSURE_DATA_CUT_NUMBER = <nnnn for AUTO only>

SQRT_MINIMUM_PIXEL           = nnnnn      /* Occurs only if SQRT is used */
SQRT_MAXIMUM_PIXEL           = nnnnn      /* Occurs only if SQRT is used */
DARK_CURRENT_DOWNLOAD_FLAG   = <TRUE or FALSE>
DARK_CURRENT_CORRECTION_FLAG = <TRUE or FALSE>
FLAT_FIELD_CORRECTION_FLAG   = <TRUE or FALSE>
BAD_PIXEL_REPLACEMENT_FLAG   = <TRUE or FALSE>
SHUTTER_EFFECT_CORRECTION_FLAG = <TRUE or FALSE>
SQRT_COMPRESSION_FLAG        = <TRUE or FALSE>

/* Compression Information, occurs only if compression was used */
INSTRUMENT_COMPRESSION_BLK_SIZE = <(1,n) or (8,8)>
INSTRUMENT_COMPRESSION_BLOCKS   = nnnnn
INSTRUMENT_COMPRESSION_DESC     = "string describing the compression type"
INSTRUMENT_COMPRESSION_MODE     = <n for JPEG only>
INSTRUMENT_COMPRESSION_PARAM    = <nn for JPEG only>
INSTRUMENT_COMPRESSION_QUALITY  = <nn for JPEG only>
INSTRUMENT_COMPRESSION_Q_TABLE_ID = <nn for JPEG only>
INSTRUMENT_COMPRESSION_Q_TABLE  = <Array of 64 elements>
INSTRUMENT_COMPRESSION_Q_TYPE   = <TABULAR for JPEG only>
INSTRUMENT_COMPRESSION_SYNC_RATE = <nnnn for RICE only>
INSTRUMENT_COMPRESSION_TYPE     = <"JPEG Discrete Cosine Transform (DCT)" or
                                "Rice Adaptive Variable-length Coding (RICE)">
INSTRUMENT_COMPRESSION_RATE     = fff.fff
INSTRUMENT_COMPRESSION_RATIO    = fff.fff

```

Figure A. — Template of Mars Pathfinder IMP EDR PDS Label File (continued)

```

PIXEL_AVERAGING_HEIGHT      = nn
PIXEL_AVERAGING_WIDTH       = nn
RICE_START_OPTION           = <nn for RICE only>
RICE_OPTION_NUMBER          = <nn for RICE only>

/* Image mosaic characteristics - Not part of PDS data products */
AZIMUTH_OF_SAMPLE_ONE       = nnnn
MAP_PROJECTION_TYPE         = name of projection
MOSAIC_RESOLUTION           = <ffff.fff for mosaics only>
MOSAIC_REFERENCE_LINE       = <ffff.fff for mosaics only>
MOSAIC_REFERENCE_SAMPLE     = <ffff.fff for mosaics only>
MOSAIC_REFERENCE_AZIMUTH    = <ffff.fff for mosaics only>
MOSAIC_REFERENCE_ELEVATION  = <ffff.fff for mosaics only>
NADIR_LINE                  = <nnnnn for mosaics only>
NADIR_SAMPLE                = <nnnnn for mosaics only>
ORIENTATION                  = "zero azimuth is up"
RADIAL_MOSAIC_RESOLUTION    = <ffff.fff for mosaics only>
ZERO_ELEVATION_IMAGE_LINE   = <nnnnn for mosaics only>

/* Calibration header fields (TBD) */

/* Image Object */
OBJECT                       = IMAGE
    LINES                     = nnnn
    LINE_SAMPLES              = nnnn
    SAMPLE_TYPE               = MSB_UNSIGNED_INTEGER
    SAMPLE_BITS               = <8 or 16 or 32>
    SAMPLE_BIT_MASK           = <mask>
    CHECKSUM                  = <32-bit integer value>
    FIRST_LINE                = nnnn
    FIRST_LINE_SAMPLE         = nnnn
END_OBJECT                   = IMAGE
END

```

## 2.2 File Naming Conventions

The following naming convention standard for IMP image data files is to be maintained by MIPS as a means of files management. It is suggested for all end-users of the products.

### 2.2.1 VICAR Image Data File Names

For all data files stored in the MIPS Working Mission Storage (WMS), the filenames will be constructed with five parts as shown below in Figure B.

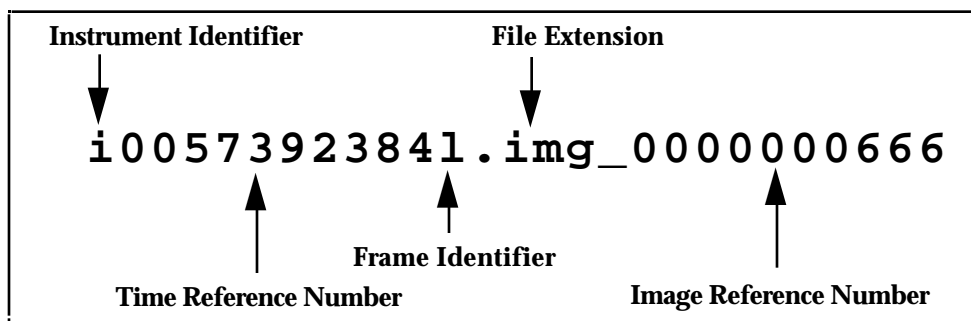


Figure B. — Sample Image File Name

**Instrument Identifier** - The instrument identifier will always be the lowercase letter 'i', representing the IMP camera.

**Time Reference Number** - The time reference number will be the 10-digit Spacecraft Clock Start Count, as described in Appendix A. The Spacecraft Clock Start Count is the same for left, right, null strip and dark strip images.

**Frame Identifier** - The frame identifier will be a one character letter, 'l', 'r', 's', or 'n', referring to an image generated from the left, right, dark or null IMP frame respectively.

**File Extension** - The file extension is a three character mnemonic. Table 3 shows the possible file extensions and the data files they represent.

Table 3. — File Extensions and Data File Types

Data File Types	File Extension
Image	.img
Dark Strip	.str
Null Strip	.nul
Flat Field	.flt
Dark Field	.drk
Histogram	.hst
Summed	.sum

**Image Reference Number** - Finally, the image reference number is the 10-digit Image ID appended onto the file extension.

### 2.2.2 PDS Data File Names

The PDS data filenames will be constructed with four of the five VICAR image data filenames components as shown below in Figure C.

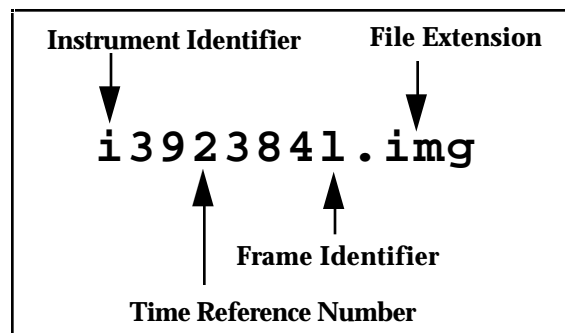


Figure C. — Sample PDS Data File Name

**Instrument Identifier** - The instrument identifier will be the lowercase letter 'i'.

**Time Reference Number** - The time reference number will be the least significant 6-digits of the Spacecraft Clock Start Count (the 4 significant digits will be used as part of the directory hierarchy storing the image files).

**Frame Identifier** - The frame identifier will be a one character letter, 'l', 'r', 's', or 'n', referring to an image generated from the left, right, dark or null IMP frame respectively.

**File Extension** - Finally, the file extension will be one of seven three-character mnemonics shown in Table 2 for the VICAR Image File Extensions.

---

## **APPENDIX A**

### **IMP PDS/VICAR EDR Label Items**

#### **A.1 IMP PDS/VICAR EDR Label Items**

The following pages list alphabetically the label items which are contained in the PDS detached and VICAR labels associated with each image file. The list is broken into four sections. The first section contains the label items that will be in every image file. The second section defines the additional label items that are present in the PDS distributed image files. The third section defines the label items that will be in a mosaiced image file. The fourth contains desired labels.



Table A-1 — Common IMP Label Items

Label Item	Description	Data Type (organization)	Valid Values
APPLICATION_PACKET_ID	Classifies the telemetry packet from which the image data was obtained. This packet ID is handed to the Telemetry download. This value is based on a set of values specified in the Downlink Telemetry Documents (JPL). This acronym is APID.	integer	(see IMP specification)
AUTO_EXPOSURE_DATA_CUT_NUMBER	A value indicating a base for pixel values using AUTO_EXPOSURE_PIXEL_FRACTION as the percentage of pixels wanted above that value.	integer	[0, 4095]
AUTO_EXPOSURE_PIXEL_FRACTION	Fraction of pixels wanted to exceed AUTO_EXPOSURE_DATA_CUT_NUMBER, expressed as a percentage. This field is valid only if EXPOSURE_TYPE is AUTO.	floating point	[0, 100.0]
AZIMUTH	Azimuth of camera at which image scene was captured, measured in degrees clockwise with respect to the Y <sub>1</sub> axis of the Mars Pathfinder Lander Coordinate Frame (L Frame). See Mars Pathfinder AIM Phasing and Coordinate Frame Document (reference 7).	floating point	[0, 360.0]
AZIMUTH_ERROR <sup>†</sup>	Estimated error in the pointing accuracy of the IMP. This error can be improved by ground processing	floating point	[0.0, 360.0]
AZIMUTH_FOV	The angular coverage of the imaged scene measured horizontally with respect to the image plane in spacecraft coordinates.	floating point	[0.0, 360.0]
AZIMUTH_MOTOR_CLICKS	Azimuth measured in IMP motor step position in counts from the low hard stop.	integer	[0, 1023]
BAD_PIXEL_REPLACEMENT_FLAG	Indicates whether or not bad pixel replacement processing was completed. If set TRUE, certain pixels of the image will be replaced based on a bad pixel table.	character (array)	TRUE, FALSE
CAMERA_ORIENTATION_QUATERNION <i>Get definition of QUATERNION for PDS</i>	A collection of four values which describe the camera model. The four values are constructed from camera C, pointing direction A, horizontal H, and vertical V. The values are mdefined in e local level coordinate system	double (array of 4 elements)	N.A.

<sup>†</sup> - for PDS labels only

\* - for Mosaic products only

Table A-1 — Common IMP Label Items

Label Item	Description	Data Type (organization)	Valid Values
DARK_CURRENT_CORRECTION_FLAG	Indicates that dark current correction processing was completed and the image was adjusted by a dark current correction image.	character (array)	TRUE, FALSE
DOWNLOAD_FLAG	Specifies which image data to download; any or all of the image data (IM), dark current strip (DS), and null pixel data (NS).	varchar (10)	NONE, DS, IM, DSIM, NS, DSNS, IMNS, DSIMNS
EARTH_RECEIVE_START_TIME	Identifies the earliest time a packet was received that contained data for the image.	character array	YYYY-MM-DDThh:mm:ss
EARTH_RECEIVE_STOP_TIME	Identifies the latest time a packet was received that contained data for the image.	character array	YYYY-MM-DDThh:mm:ss
ELEVATION	Elevation of camera at which image scene was captured, measured in degrees with respect to the $X_1/Y_1$ plane of the Mars Pathfinder Lander Coordinate Frame (L Frame). Positive degrees are measured above the $X_1/Y_1$ plane (negative $Z_1$ direction). See Mars Pathfinder AIM Phasing and Coordinate Frame Document (reference 7).	floating point	[-90.0, 90.0]
ELEVATION_ERROR†	Estimated error in the pointing accuracy of the IMP. This error can be improved by ground processing	floating point	[0.0, 90.0]
ELEVATION_FOV	The angular coverage of the imaged scene measured vertically with respect to the image plane in spacecraft coordinates.	floating point	[0.0, 90.0]
ELEVATION_MOTOR_CLICKS	Elevation measured in IMP motor step position in counts from the low hard stop.	integer	[0, 1023]
ERROR_PIXELS	Count of the number of pixels that are outside of the valid Dn range. The count is taken after all decompression and post decompression processing has completed.	integer	<any positive value>
EXPECTED_PACKETS	Total number of telemetry packets which constitute a complete image, an image without missing data.	integer	<any positive value>
EXPOSURE_COUNT	Maximum number of exposures to take. Valid values are dependent on EXPOSURE_TYPE.	integer	[0, 16]

† - for PDS labels only

\* - for Mosaic products only

Table A-1 — Common IMP Label Items

Label Item	Description	Data Type (organization)	Valid Values
EXPOSURE_DURATION	Integration time for manual and auto exposure, measured in milliseconds. Integration Time in IMP Telemetry Format specification from the U. of Arizona.	floating point	[0.5, 32767.5]
EXPOSURE_TYPE	Exposure type for the image: auto, manual, pre-timed, incremental or none. Auto exposure allows for adjusting the expose time based on a previous exposure. Manual exposure is a single exposure with a set expose time. Pre-timed exposure uses the very last expose time used, regardless of what kind of exposure it was. No exposure indicates that the command moves only the camera and doesn't take an exposure.	character (array)	AUTO, INCREMENTAL MANUAL, PRETIMED, NONE
FILTER_NAME	The name of the instrument filter through which the image was acquired. The number in the name refers to the effective wave length in nm of the filter for the left (L) or right (R) image.	character (array)	for flt 0, "L440_R440" for flt 1, "L450_R670" for flt 2, "L885_R947" for flt 3, "L925_R935" for flt 4, "L935_R990" for flt 5, "L670_R670" for flt 6, "L800_R750" for flt 7, "L860_R-DIOPTER" for flt 8, "L900_R600" for flt 9, "L930_R530" for 10, "L1000_R480" for 11, "L965_R965"
FILTER_NUMBER	The number of the instrument filter through which the image was acquired.	integer	[0, 11]
FIRST_LINE	Indicates the line within a source image that corresponds to the first line in a sub-image.	integer	[1, 256]
FIRST_LINE_SAMPLE	Indicates the sample within a source image that corresponds to the first sample in a sub-image.	integer	[1, 256]
FLAT_FIELD_CORRECTION_FLAG	Indicates whether or not flat field correction processing was completed. If set TRUE, the image has been adjusted by a flat field correction image.	character (array)	TRUE, FALSE

† - for PDS labels only

\* - for Mosaic products only

Table A-1 — Common IMP Label Items

Label Item	Description	Data Type (organization)	Valid Values
FOCAL_CENTER_VECTOR	Position of the entrance pupil point of the camera lens (focal center) measured relative to the Lander coordinate frame (L Frame) [7]. Corresponds to the C vector in the CAHV camera model.	floating point (array of 3 elements)	N.A.
FRAME_ID	Provides an identification for a particular instrument measurement frame.	character (array)	FRAME_LEFT, FRAME_RIGHT, FRAME_BOTH, FRAME_LEFT_HALF
HORIZONTAL_IMAGE_PLANE_VECTOR	$\mathbf{H} = \mathbf{H}' + x_c \mathbf{A}$ , where $\mathbf{H}'$ is a unit vector parallel to the x-axis in the camera's image plane, and $x_c$ is the point of intersection of a perpendicular dropped from the exit pupil point of the camera lens. $\mathbf{H}'$ , $\mathbf{A}$ , $\mathbf{V}$ are mutually orthogonal. All the vectors are defined in the Lander coordinate frame (L Frame) [7]. Corresponds to the H vector in the CAHV camera model.	floating point (array of 3 elements)	N.A.
IMAGE_ID	10-digit number that uniquely identifies the observation parameters of an image. The most significant 4 digits identify the command sequence that contains the imaging command. If the image ID is even and non-zero, then this is the left frame from the camera. If the image ID is one greater than the left frame image ID (odd), then this is the right frame of a stereo image.	integer	<any positive value>
IMAGE_OBSERVATION_TYPE	Image data type as specified in the image packet as image information bits.	character (array)	REGULAR, DARK_CURRENT , FLAT_FIELD, HISTOGRAM, SUMMATION, DARK_STRIP, NULL_STRIP
IMAGE_TIME	Time at which the image was acquired, recorded in UTC format. Synonymous to SPACECRAFT_CLOCK_START_COUNT.	character (array)	YYYY-MM-DDThh:mm:ss.ffff

† - for PDS labels only

\* - for Mosaic products only

Table A-1 — Common IMP Label Items

Label Item	Description	Data Type (organization)	Valid Values
INSTRUMENT_COMPRESSION_BLK_SIZE	Dimension of a block for on-board compression; line dimension of the block is the first element, followed by the sample dimension of the block.	integer (array)	for Rice, (1*n) where n ranges from 4 to 24. for JPEG, (8,8)
INSTRUMENT_COMPRESSION_BLOCKS	Number of blocks used to spatially segment the image file prior to on-board compression.	integer	<any positive value that is the image number of pixels divided by the block area>
INSTRUMENT_COMPRESSION_MODE	JPEG specific variable. Selects on-board compression target of image quality or compression factor in conjunction with Huffman or arithmetic entropy encoding with or without LCT. Odd modes select image quality, while even modes select compression factor as a target. Modes 1,2,5,6 use Huffman encoding; modes 3,4,7,8 use arithmetic encoding. Modes 5 through 8 use LCT.	integer	[1, 8]
INSTRUMENT_COMPRESSION_PARAM	JPEG specific variable. Selects on-board compression rate by image quality or by compression factor, based on selected on-board compression mode.	integer	if compression mode is odd, [1, 99]; if compression mode is even, [2, 225].
INSTRUMENT_COMPRESSION_Q_TABLE_ID	This name or code identifies the reference table used for quantization in the frequency domain for on-board transform compression. This name or code should be specific enough to allow the user of the data to have sufficient information to reference the quantization table used to compress the data.	character (array)	[0, 15]
INSTRUMENT_COMPRESSION_QUALITY	JPEG specific variable. If an odd IMP compression mode is used for on-board compression, this is the desired image quality index. If an even IMP compression mode is used, this is the resultant image quality used to reach a desired on-board compression factor.	integer	[1, xxxx]
INSTRUMENT_COMPRESSION_RATE	Average number of bits needed to represent a pixel with an on-board compressed image.	floating point	<any positive value>

† - for PDS labels only

\* - for Mosaic products only

Table A-1 — Common IMP Label Items

Label Item	Description	Data Type (organization)	Valid Values
INSTRUMENT_COMPRESSION_RATIO	Ratio in bytes of the original, uncompressed data file length to its compressed form. For example, a compression ratio of 5.00 means that on average, for every five bytes of input data, one byte of on-board compressed data was generated.	floating point	<any positive value>
INSTRUMENT_COMPRESSION_SYNC_RATE	Rice specific variable. Number of compressed blocks between sync markers.	integer	[1, 1024]
INSTRUMENT_COMPRESSION_TYPE	The type of on-board compression used for data storage and transmission. Contents of this value should be the full, unabbreviated, non-acronym name of coding or compression type. Examples of encoding types include but are not limited to Integer Cosine Transform (ICT), Block Truncation Coding (BTC), Discrete Cosine Transform (DCT), Joint Photographic Experts Group (JPEG) Standard DCT.	character (array)	"Rice Adaptive Variable-length Coding (RICE)" or "JPEG Discrete Cosine Transform (DCT)" or NONE
INSTRUMENT_DEPLOYMENT_STATE_ID	Defines the position of the IMP mast	character (array)	STOWED, DEPLOYED, UNKNOWN
INSTRUMENT_TEMPERATURE	The temperature of the sensor (CCD) array and camera head when the image was acquired, measured in Kelvin.	floating point (array of 2 elements)	<any positive value>
INSTRUMENT_NAME	Full name of an instrument.	character (array)	Imager for Mars Pathfinder (IMP)
LANDER_SURFACE_QUATERNION	A set of four values the define the relationship between the Lander Frame and Local Level Frame coordinate systems [7].	double (array of 4 elements)	N.A
LOCAL_TIME	Reference time based on the IAU standard for the Martian prime meridian. For detailed description, see the Report of the IAU/IAG/COSPAR Working Group on Cartographic Coordinates and Rotational Elements of the Planets and Satellites: 1991.	character (array)	hh:mm:ss.fff
MAXIMUM	The maximum Dn value in the image file, between the IMP CCD valid range (0 to 4095).	integer	[0, 4095]

† - for PDS labels only

\* - for Mosaic products only

Table A-1 — Common IMP Label Items

Label Item	Description	Data Type (organization)	Valid Values
MEAN	The mean pixel value for the pixels within the valid Dn range.	floating point	[0.0, 4095.0]
MEDIAN	The median pixel value for the pixels within the valid Dn range. This value will be at most 8 Dn greater than or equal to the true median value.	integer	[0, 4095]
MINIMUM	The minimum Dn value in the image file, between the IMP CCD valid range (0 to 4095).	integer	[0, 4095]
MISSION_NAME	A major planetary mission or project.	character (array)	MARS PATHFINDER
MLL_MFX_OFFSET_ERROR	An array of X, Y, and Z, measured in millimeters, defining the error range of the MLL to MFX offset determination.	floating point (array of 3 elements)	N.A.
MLL_MFX_OFFSET_VECTOR	An array of X, Y, and Z offsets in millimeters from the origin of the Lander Frame (L Frame) to the Mars Surface Fixed Frame (MFX Frame). [7]	floating point (array of 3 elements)	N.A.
PIXEL_AVERAGING_HEIGHT	Block height for pixel averaging prior to image compression.	integer	[1, 255] required that $\text{mod}(\text{LINES} / (\text{PIXEL\_AVERAGING\_HEIGHT})) = 0$
PIXEL_AVERAGING_WIDTH	Block width for pixel averaging prior to image compression.	integer	[1, 255] required that $\text{mod}(\text{SAMPLES} / (\text{PIXEL\_AVERAGING\_WIDTH})) = 0$
POINTING_DIRECTION_VECTOR	A unit vector A in the direction in which the first (or second) camera is pointed; the direction of the symmetry axis of the camera lens as measure in the external coordinate system. All the vectors are defined in the Lander coordinate frame (L Frame) [7]. Corresponds to the A vector in the CAHV camera model.	floating point (array of 3 elements)	<TBD>

† - for PDS labels only

\* - for Mosaic products only

Table A-1 — Common IMP Label Items

Label Item	Description	Data Type (organization)	Valid Values
PRODUCER_ID	Short name or acronym for the producer or producing team/group of a dataset.	character (array)	"LPL of UofA and MIPS of JPL"
PRODUCT_CREATION_TIME	Defines the UTC time when a product was created.	time	YYYY-MM-DDThh:mm:ss
PRODUCT_ID	A permanent, unique identifier assigned to a data product by its producer.	character (array)	"IMP_EDR-<SCLK_start_count>-<image_observation_type>-<image id>"
RECEIVED_PACKETS	Total number of telemetry packets which constitute the reconstructed image.	integer	<any positive value>
RICE_OPTION_NUMBER	RICE compressor specific variable.	integer	between 2 and (data precision - start_option + 1)
RICE_START_OPTION	RICE compressor specific variable.	integer	between 0 and the data precision of pixels
SHUTTER_EFFECT_CORRECTION_FLAG	A command flag set in the IMP Flight Software Command to remove the shutter, or fixed-pattern, from the image.	character (array)	TRUE, FALSE
SOFTWARE_VERSION_ID	Identifies the version of the telemetry processing software used to generate the image data.	character (array)	N.A.
SOURCE_PRODUCT_ID	Filenames of SPICE kernels used to produce image data and derived data.	character (array)	<standard SPICE kernel names for PCK, SPK, etc.>
SPACECRAFT_CLOCK_START_COUNT	Lander time in seconds at which the image was acquired. Image Generation Time in the IMP Telemetry Format specification from the U. of Azirona. Synonymous to IMAGE_TIME.	integer	N.A.
SPACECRAFT_NAME	Full, unabbreviated name of a spacecraft.	character (array)	PATHFINDER LANDER
SQRT_COMPRESSION_FLAG	Flag for on-board square root compressing a 12 bit pixel down to an 8 bit pixel.	character (array)	TRUE, FALSE

† - for PDS labels only

\* - for Mosaic products only



Table A-1 — Common IMP Label Items

Label Item	Description	Data Type (organization)	Valid Values
SQRT_MAXIMUM_PIXEL	Maximum pixel value in 12-bit image prior to square root compression.	integer	[0, 4095]
SQRT_MINIMUM_PIXEL	Minimum pixel value in 12-bit image prior to square root compression.	integer	[0, 4095]
STANDARD_DEVIATION	Standard deviation of the valid pixel values around the mean Dn value.	floating point	[0.0, 4095.0]
SURFACE_BASED_CAMERA_AZIMUTH	Azimuth of IMP camera measured in the Mars Surface Fixed frame (MFX frame). Azimuth is measured positively in degrees clockwise from the Martian north (spin axis), projected onto the local gravity horizontal plane (plane perpendicular to the gravity vector). Also generally known as NORTH_AZIMUTH. Mars Local Level or surface fixed coordinate system.	floating point	[0.0, 360.0]
SURFACE_BASED_CAMERA_AZIMUTH_ERROR	Estimated error in the pointing accuracy of the IMP. This error can be improved by ground processing	floating point	[0.0, 360.0]
SURFACE_BASED_CAMERA_ELEVATION	Elevation of IMP camera measured in the Mars Surface Fixed frame (MFX frame). Elevation is measured in degrees up from the Mars Local Level or Surface Fixed X,Y plane.	floating point	[-90.0, 90.0]
SURFACE_BASED_CAMERA_ELEVATION_ERROR	Estimated error in the pointing accuracy of the IMP. This error can be improved by ground processing	floating point	[0.0, 90.0]
TARGET_NAME	Identifies a target, be it a planetary body, region or feature.	character (array)	<Mars or some Martian feature>
TLM_CMD_DISCREPANCY_FLAG	Indicator of mismatch(es) found between IMP commands uplinked and IMP telemetry.	character (array)	TRUE, FALSE
VERTICAL_IMAGE_PLANE_VECTOR	$V = V' + y_c A$ , where $V'$ is a unit vector parallel to the y-axis in the camera's image plane, and $y_c$ is the point of intersection of a perpendicular dropped from the exit pupil point of the camera lens. $H'$ , $A'$ , $V'$ are mutually orthogonal. All the vectors are defined in the Lander coordinate frame (L Frame) [7]. Corresponds to the V vector in the CAHV camera model.	floating point (array of 3 elements)	N.A.

† - for PDS labels only

\* - for Mosaic products only

Table A-2 — PDS IMP Label Items

Label Item	Description	Data Type (organization)	Valid Values
APID_DESCRIPTION <sup>†</sup>	Group name associated with APID. An example is "Lander image of the Rover" for APID #26.	character (array)	<any descriptive text>
BANDS <sup>†</sup>	Indicates the number of spectral bands in the image.	integer	1
CHECKSUM <sup>†</sup>	An unsigned 32-bit sum of all data in the image data object.	integer	<any positive value>
COMMAND_DESCRIPTION <sup>†</sup>	Text which describes the uplinked command as found in COMMAND_NAME element.	varchar (200)	<text taken directly from the Mars Pathfinder Command Dictionary, appendix A, D-12500>
DARK_CURRENT_DOWNLOAD_FLAG <sup>†</sup>	Indicates if a dark current strip of the CCD was downlinked along with the image data.	character (array)	TRUE, FALSE
DATA_SET_ID <sup>†</sup>	A unique alphanumeric identifier for a data set or a data product. This identifier consists of the identifiers for spacecraft, target, instrument, processing level, product acronym, and version number.	character (array)	"MPF-M-IMP-2-EDR-Vx.x"
DATA_SET_NAME <sup>†</sup>	Full name given to a data set or product. This is an unabbreviated version of the DATA_SET_ID.	character (array)	N.A.
DETECTOR_PIXEL_HEIGHT <sup>†</sup>	Height of pixel measured in microns.	floating point	<TBD>
DETECTOR_PIXEL_WIDTH <sup>†</sup>	Width of pixel measured in microns.	floating point	<TBD>
FILE_RECORDS <sup>†</sup>	Number of physical file records.	integer	<any positive value>
INSTRUMENT_COMPRESSION_DESC <sup>†</sup>	Textual description of encoding type, which should include a reference to a journal paper, published text or some other publicly available, published material which definitively describes the on-board compression type.	character (array)	N.A.
INSTRUMENT_COMPRESSION_Q_TYPE <sup>†</sup>	Method of quantization used for the output of transform coders	character (array)	TABULAR

<sup>†</sup> - for PDS labels only

\* - for Mosaic products only

Table A-2 — PDS IMP Label Items

Label Item	Description	Data Type (organization)	Valid Values
INTERCHANGE_FORMAT <sup>†</sup>		character (array)	
LINES <sup>†</sup>	Total number of pixels along the vertical axis of an image.	integer	<any positive value>
LINE_SAMPLES <sup>†</sup>	Total number of pixels along the horizontal axis of an image.	integer	<any positive value>
MOTOR_CLICKS_TO_AZIMUTH_TRANSFORM <sup>†</sup>	Formula used to convert IMP motor steps to camera azimuth in the IMP frame.	character string	N.A.
MOTOR_CLICKS_TO_ELEVATION_TRANSFORM <sup>†</sup>	Formula used to convert IMP motor steps to camera elevation in the IMP frame.	character string	N.A.
PDS_VERSION_ID <sup>†</sup>	The version number of the PDS standards documents that is valid when a data product is created.	character (array)	3 or greater
PROCESSING_HISTORY_TEXT <sup>†</sup>	Textual summation that provides an entry for each processing step and program used in generating a particular data file in the context of the Ground Data System.	character (array)	N.A.
PRODUCER_FULL_NAME <sup>†</sup>	Full, unabbreviated name of the individual mainly responsible for the production of the data set.	character (array)	"Dr, Peter Smith, the IMP Team, and JPL MIPS"
PRODUCER_INSTITUTION_NAME <sup>†</sup>	Identifies the institution associated with the production of the data set.	character (array)	"Lunar and Planetary Laboratory, University of Arizona in concert with Multimission Image Processing Subsystem of Jet Propulsion Laboratory"
RECORD_BYTES <sup>†</sup>	Number of bytes in a physical file record, including record terminators and separators.	integer	80
RECORD_TYPE <sup>†</sup>	Record format of a file.	character (array)	FIXED_LENGTH
SAMPLE_BITS <sup>†</sup>	Indicates the stored number of bits, or units of binary information, contained in a line_sample value.	integer	8, 16, 32

<sup>†</sup> - for PDS labels only

\* - for Mosaic products only

Table A-2 — PDS IMP Label Items

Label Item	Description	Data Type (organization)	Valid Values
SAMPLE_BIT_MASK <sup>†</sup>	Identifies the active bits in a sample.	character	2#11111111#, 2#0000111111111111# or mask of 32 bits(all on)
SAMPLE_TYPE <sup>†</sup>	Data storage representation of sample value.	character (array)	MSB_UNSIGNED_ INTEGER

<sup>†</sup> - for PDS labels only

\* - for Mosaic products only

Table A-3— Mosaic IMP Label Items

Label Item	Description	Data Type (organization)	Valid Values
AZIMUTH_OF_SAMPLE_ONE*	Identifies azimuth of the first column.	floating point	<any positive number>
MAP_PROJECTION_TYPE*	Identifies the type of projection characteristic of a given map.	character (array)	SIMPLE_CYLINDRICAL, POLAR_SIMPLE_CYLINDRICAL
MOSAIC_REFERENCE_AZIMUTH*	Recomputed commanded azimuth of camera used to construct the image mosaic.	floating point	<TBD>
MOSAIC_REFERENCE_ELEVATION*	Recomputed commanded elevation of camera used to construct the image mosaic.	floating point	<TBD>
MOSAIC_REFERENCE_LINE*	Line number of the upper left corner of the mosaic in CAHV pixel coordinates.	floating point	<TBD>
MOSAIC_REFERENCE_SAMPLE*	Sample number of the upper left corner of the mosaic in CAHV pixel coordinates.	floating point	<TBD>
MOSAIC_RESOLUTION*	The ratio of one pixel to the distance measured in degrees between any two adjacent rows or two adjacent columns in a mosaicked image.	floating point	N.A.
NADIR_LINE*	Line to which the nadir projects provided the horizon is level in the image. Otherwise, it is the line to which -90 degrees elevation projects in local camera coordinates.	floating point	N.A.
NADIR_SAMPLE*	Sample to which the nadir projects provided the horizon is level in the image. Otherwise, it is the sample to which -90 degrees elevation projects in local camera coordinates.	floating point	N.A.
ORIENTATION*	Textual description of mosaicked image orientation with respect to the North pole of the target body.	character (array)	"zero azimuth is up"
RADIAL_MOSAIC_RESOLUTION*	The number of pixels per degree in the direction out from the nadir point.	floating point	N.A.
ZERO_ELEVATION_IMAGE_LINE*	Line in image at which zero elevation is found.	integer	N.A.

† - for PDS labels only

\* - for Mosaic products only

Table A-3— *Mosaic IMP Label Items*

Label Item	Description	Data Type (organization)	Valid Values
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NOTE: Mosaics images do not contain any other property labels other than the Mosaic Property label. The other property labels would not contain accurate information and would be more misleading than helpful.

† - for PDS labels only  
\* - for Mosaic products only

Table A-4 — Desirable IMP Label Items

Label Item	Description	Data Type (organization)	Valid Values
INERTIAL_TO_AREOCENTRIC_TRANSFORM	The coordinate transformation from J2000 inertial frame to the body-fixed, planetocentric frame of Mars. This transformation is defined in terms of right ascension, declination, angular offset of the prime meridian of Mars as stored in the PCK kernel file provided by NAIF.	double (array)	N.A.
INSTRUMENT_COMPRESSION_Q_TABLE	This is the contents of the quantization table specified by QUANTIZATION_TABLE_ID, an array of integers.	integer (array)	N.A.
MBF_TO_MBF_TRANSFORM	The coordinate transformation from Mars Surface Fixed frame (MBF frame) to the body-fixed frame of Mars (MBF frame).	double (array)	N.A.
SOLAR_AZIMUTH (May be eliminated due to limited resources ... available in SPICE kernels)	The angular distance in a horizontal direction of the sun relative to the camera pointing for a particular image, measured in degrees clockwise in a spherical coordinate system.	floating point	[0, 360.0]
SOLAR_ELEVATION (May be eliminated due to limited resources ... available in SPICE kernels)	The angular distance in a vertical direction of the sun relative to the horizon as seen by the camera, measured in degrees up in a spherical coordinate system.	floating point	[-90.0, 90.0]
SPACECRAFT_ALTITUDE (May be eliminated due to limited resources ... available in SPICE kernels)	Distance (in meters) above gravitational center of Mars.	floating point	N.A.
SPACECRAFT_LATITUDE (May be eliminated due to limited resources ... available in SPICE kernels)	Latitude on Mars at which the spacecraft rests using a Planetocentric coordinate system.	floating point	[-90.0, 90.0]
SPACECRAFT_LONGITUDE (May be eliminated due to limited resources ... available in SPICE kernels)	Degrees of East Longitude on Mars at which the spacecraft rests using a planetocentric coordinate system.	floating point	[0.0, 360.0]
SURFACE_NORMAL_AZIMUTH (May be eliminated due to limited resources ... available in SPICE kernels)	Azimuthal measure of surface normal at the ground intersection point from the geometric center of the Lander base to the gravitational center of Mars.	floating point	N.A.
SURFACE_NORMAL_ELEVATION (May be eliminated due to limited resources ... available in SPICE kernels)	Elevational measure of surface normal at the ground intersection point from the geometric center of the Lander base to the gravitational center of Mars.	floating point	N.A.

† - for PDS labels only

\* - for Mosaic products only

Table A-4 — *Desirable IMP Label Items*

Label Item	Description	Data Type (organization)	Valid Values
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† - for PDS labels only  
 \* - for Mosaic products only



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## **APPENDIX B**

### **IMP VICAR Property and Task Labels**

#### **B.1 IMP VICAR Property and Task Labels**

The following pages contain alphabetical listings of the VICAR label items which are placed in the header of each image file. The listings are arranged by VICAR property or task name.

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VICAR LABEL ITEM

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**CAMERA\_MODEL Property**

AZIMUTH  
AZIMUTH\_ERROR  
AZIMUTH\_FOV  
AZIMUTH\_MOTOR\_CLICKS  
CAMERA\_ORIENTATION\_QUATERNION  
ELEVATION  
ELEVATION\_ERROR  
ELEVATION\_FOV  
ELEVATION\_MOTOR\_CLICKS  
FOCAL\_CENTER\_VECTOR  
HORIZONTAL\_IMAGE\_PLANE\_VECTOR  
LANDER\_SURFACE\_QUATERNION  
MLL\_MFX\_OFFSET\_ERROR  
MLL\_MFX\_OFFSET\_VECTOR  
POINTING\_DIRECTION\_VECTOR  
SURFACE\_BASED\_CAMERA\_AZIMUTH  
SURFACE\_BASED\_CAMERA\_AZIMUTH\_ERROR  
SURFACE\_BASED\_CAMERA\_ELEVATION  
SURFACE\_BASED\_CAMERA\_ELEVATION\_ERROR  
VERTICAL\_IMAGE\_PLANE\_VECTOR

**IMP\_COMMANDS Property**

AUTO\_EXPOSURE\_DATA\_CUT\_NUMBER  
AUTO\_EXPOSURE\_PIXEL\_FRACTION  
BAD\_PIXEL\_REPLACEMENT\_FLAG  
DARK\_CURRENT\_CORRECTION\_FLAG  
DOWNLOAD\_FLAG  
EXPOSURE\_COUNT  
FLAT\_FIELD\_CORRECTION\_FLAG  
SHUTTER\_EFFECT\_CORRECTION\_FLAG  
SQRT\_COMPRESSION\_FLAG

**DECOMPRESSED Property**

INSTRUMENT\_COMPRESSION\_BLK\_SIZE  
INSTRUMENT\_COMPRESSION\_BLOCKS  
INSTRUMENT\_COMPRESSION\_MODE  
INSTRUMENT\_COMPRESSION\_PARAM  
INSTRUMENT\_COMPRESSION\_Q\_TABLE\_ID  
INSTRUMENT\_COMPRESSION\_QUALITY  
INSTRUMENT\_COMPRESSION\_RATE  
INSTRUMENT\_COMPRESSION\_RATIO  
INSTRUMENT\_COMPRESSION\_SYNC\_RATE  
INSTRUMENT\_COMPRESSION\_TYPE  
PIXEL\_AVERAGING\_HEIGHT  
PIXEL\_AVERAGING\_WIDTH  
RICE\_OPTION\_NUMBER  
RICE\_START\_OPTION  
SQRT\_MAXIMUM\_PIXEL  
SQRT\_MINIMUM\_PIXEL

**MOSAIC Property**

*(valid for mosaics only)*

AZIMUTH\_OF\_SAMPLE\_ONE  
MAP\_PROJECTION\_TYPE  
MOSAIC\_REFERENCE\_AZIMUTH  
MOSAIC\_REFERENCE\_ELEVATION  
MOSAIC\_REFERENCE\_LINE  
MOSAIC\_REFERENCE\_SAMPLE  
MOSAIC\_RESOLUTION  
NADIR\_LINE  
NADIR\_SAMPLE  
ORIENTATION  
RADIAL\_MOSAIC\_RESOLUTION  
ZERO\_ELEVATION\_IMAGE\_LINE

**MPFTELEMPROC Property**

EARTH\_RECEIVE\_START\_TIME  
EARTH\_RECEIVE\_STOP\_TIME  
EXPECTED\_PACKETS  
INSTRUMENT\_NAME  
MISSION\_NAME  
PRODUCER\_ID  
PRODUCT\_CREATION\_TIME  
PRODUCT\_ID  
RECEIVED\_PACKETS  
SOFTWARE\_VERSION\_ID  
SOURCE\_PRODUCT\_ID  
SPACECRAFT\_NAME  
TLM\_CMD\_DISCREPANCY\_FLAG

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VICAR LABEL ITEM

---

**OBSERVATION Property**

APPLICATION\_PACKET\_ID  
ERROR\_PIXELS  
EXPOSURE\_DURATION  
EXPOSURE\_TYPE  
FILTER\_NAME  
FILTER\_NUMBER  
FIRST\_LINE  
FIRST\_LINE\_SAMPLE  
FRAME\_ID  
IMAGE\_ID  
IMAGE\_OBSERVATION\_TYPE  
IMAGE\_TIME  
INSTRUMENT\_DEPLOYMENT\_STATE\_ID  
INSTRUMENT\_TEMPERATURE  
LOCAL\_TIME  
MAXIMUM  
MEAN  
MEDIAN  
MINIMUM  
SPACECRAFT\_CLOCK\_START\_COUNT  
STANDARD\_DEVIATION  
TARGET\_NAME

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VICAR LABEL ITEM

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**PDS Label items**

APID\_DESCRIPTION  
BANDS  
CHECKSUM  
COMMAND\_DESCRIPTION  
DARK\_CURRENT\_DOWNLOAD\_FLAG  
DATA\_SET\_ID  
DATA\_SET\_NAME  
DETECTOR\_PIXEL\_HEIGHT  
DETECTOR\_PIXEL\_WIDTH  
FILE\_RECORDS  
INSTRUMENT\_COMPRESSION\_DESC  
INSTRUMENT\_COMPRESSION\_Q\_TYPE  
INTERCHANGE\_FORMAT  
LINES  
LINE\_SAMPLES  
MOTOR\_CLICKS\_TO\_AZIMUTH\_TRANSFORM  
MOTOR\_CLICKS\_TO\_ELEVATION\_TRANSFORM  
PDS\_VERSION\_ID  
PROCESSING\_HISTORY\_TEXT  
PRODUCER\_FULL\_NAME  
PRODUCER\_INSTITUTION\_NAME  
RECORD\_BYTES  
RECORD\_TYPE  
SAMPLE\_BITS  
SAMPLE\_BIT\_MASK  
SAMPLE\_TYPE

**Desirable items**

INERTIAL\_TO\_AREOCENTRIC\_TRANSFORM  
INSTRUMENT\_COMPRESSION\_Q\_TABLE  
MFX\_TO\_MBF\_TRANSFORM  
SOLAR\_AZIMUTH  
SOLAR\_ELEVATION  
SPACECRAFT\_ALTITUDE  
SPACECRAFT\_LATITUDE  
SPACECRAFT\_LONGITUDE  
SURFACE\_NORMAL\_AZIMUTH  
SURFACE\_NORMAL\_ELEVATION

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## **APPENDIX C**

### **IMPSOFT Label Description**

#### **C.1 IMPSOFT Label Description**

The following pages contain describe the sequence of IMP DISRSOFT header fields.

IMPSOFT LABEL Item & Name	Description and/or FSW Structure Element (PDS keyword in <b>boldface</b> )
0 H_TYPE	Header type (D=DISR, I=IMP)='I'
1 H_DIRECTORY	Directory file last stored in
2 H_FILENAME	Filename file was stored as
3 H_FILETIME	Time file was last written by D_WRITE
4 H_LENGTH	Length of header string array
5 H_DIMENSION	Number of dimensions in data ='2'
6 H_XSIZE	Number of columns (default(256, strip=8), or cmd->col_max - cmd->col_min +1) telem->num_rows <b>PDS LINE_SAMPLES</b>
7 H_YSIZE	Number of rows (default(256, strip=8), or cmd->row_max - cmd->row_min +1) telem->num_cols <b>PDS LINES</b>
8 H_ZSIZE	Number of images unused
9 H_DATATYPE	Type of data = DB_WORD <b>PDS SAMPLE_BITS</b>
10 H_EXTENSION	Position in header where extension area starts
11 H_EXTRA	Position in header where extra area starts
12 H_PROCESS	Position in header where processing area starts <b>PDS PROCESSING_HISTORY_TEXT</b> <end of required DISRSOFT header fields>
13 H_PURPOSE	Purpose of observation bce d_purpose <b>PDS APID_DESCRIPTION</b>
14 H_SUBJECT	Subject of observation bce d_subject <b>PDS TARGET_NAME</b>
15 H_DATE	Date observation made <b>PDS IMAGE_TIME</b>

IMPSOFT LABEL Item & Name	Description and/or FSW Structure Element (PDS keyword in <b>boldface</b> )
16 H_ENGINEER	Engineer responsible bce d_operator <b>PDS PRODUCER_FULL_NAME</b>
17 H_SITE	Site of observation bce d_site <b>PDS PRODUCER_INSTITUTION_NAME</b>
18 H_SET_NAME	Text description of data set bce <b>PDS DATA_SET_NAME</b>
19 H_PRODUCT_ID	Unique identifier of image amongst all PDS products <b>PDS PRODUCT_ID</b>
20 H_EXPOSURE_COUN	Multiple exposure loop counter for auto expose, flat fields, dark fields cmd->expose_count <b>PDS EXPOSURE_COUNT</b>
21 H_OPTICS_TEMP	Camera optics temperature in [K]
22 H_CCDTEMP	On chip CCD temperature in [K] bce computed from telem->ccd_temperature <b>PDS SENSOR_TEMPERATURE</b>
23 H_REF_TEMP	CCD electronics reference temperature (MPAE field)
24 H_ELEVATION_R0	obsolete field for camera elevation (raw counts)
25 H_FRAME	CCD frame number cmd->frame (NOTE: overall exposure frame, not image frame) <b>PDS FRAME_ID</b>
26 H_EXPOSURE_TYPE	CCD exposure type cmd->expose_type <b>PDS EXPOSURE_TYPE</b>
27 H_AUTO_DATA_CUT	Auto Exposure cutoff pixel value cmd->data_num <b>PDS AUTO_EXPOSURE_DATA_CUT_NUMBER</b>
28 H_AUTO_PERCENT	Auto Exposure target % of pixels above cutoff value cmd->pixel_frac <b>PDS AUTO_EXPOSURE_PIXEL_FRACTION</b>
29 H_AUTO_DFLT_TIM	Auto Exposure initial exposure time cmd->integration_time
30 H_DETECTOR	Detector type (CCD, IR, PHOTOMETER) (MPAE field)



IMPSOFT LABEL Item & Name	Description and/or FSW Structure Element (PDS keyword in <b>boldface</b> )
31 H_SENSOR_ID	Sensor ID number (MPAE field)
32 H_COL_MIN	starting column of subframe cmd->col_min (if subframing) PDS <b>FIRST_LINE_SAMPLE</b>
33 H_COL_MAX	last column of subframe cmd->col_max (if subframing) PDS <b>FIRST_LINE_SAMPLE + LINE_SAMPLES - 1</b>
34 H_ROW_MIN	top row of subframe cmd->row_min (if subframing) PDS <b>FIRST_LINE</b>
35 H_ROW_MAX	bottom row of subframe cmd->row_max (if subframing) PDS <b>FIRST_LINE + LINES - 1</b>
36 H_EXPTIME	integration time [sec] for CCD measurement (float)cmd->integration_time/2000. (S.B. telem->) PDS <b>EXPOSURE_DURATION</b>
37 H_IMAGE_TIME	start time of exposure PDS <b>IMAGE_TIME</b>
38 H_ABSCAL	Absolute calibration factor used
39 H_LOCAL_TIME	PDS <b>LOCAL_TIME</b>
40 H_COMP_RATE	bits/pixel (only if compression is used) PDS <b>INSTRUMENT_COMPRESSION_RATE</b>
41 H_COMP_TYPE	compression type "None", "Lossless", "Huffman   Arithmetic Quality   Ratio" cmd->compression_type (convert to string) PDS <b>INSTRUMENT_COMPRESSION_TYPE</b>
42 H_COMP_QUALITY	quality factor for compression cmd->compression_value (if jpeg quality compression) (telem->cmpr_data_1 if jpeg compression) PDS <b>INSTRUMENT_COMPRESSION_QUALITY</b>
43 H_COMP_RATIO	compression ratio cmd->compression_value (if jpeg ratio compression) PDS <b>INSTRUMENT_COMPRESSION_RATIO</b>
44 H_Q_TABLE	Q table for compression cmd->Q_table (if doing jpeg compression) PDS <b>INSTRUMENT_COMPRESSION_Q_TABLE_ID</b>

IMPSOFT LABEL Item & Name	Description and/or FSW Structure Element (PDS keyword in <b>boldface</b> )
45 H_AC_TABLE	AC table for Huffman compression cmd->AC_table (if doing jpeg huffman compression)
46 H_DC_TABLE	DC table for Huffman compression cmd->DC_table (if doing jpeg huffman compression)
47 H_SQRT_COMPRESS	Square root compression/correction type cmd->sqrt_type (if used) (telem->image_info[1:3]) PDS <b>SQRT_COMPRESSION_TYPE</b>
48 H_BLOCK_SIZE	Obsolete??
49 H_CCD_SIDE	CCD side exposed for this image cmd->frame PDS <b>FRAME_ID</b>
50 H_COORD_XL	image coordinates (lower x) (MPAE field)
51 H_COORD_YL	image coordinates (lower y) (MPAE field)
52 H_COORD_XU	image coordinates (upper x) (MPAE field)
53 H_COORD_YU	image coordinates (upper y) (MPAE field)
54 H_FILTER	filter number in use cmd->filter_num (telem->filter_num) PDS <b>FILTER_NUMBER</b>
55 H_GAIN	gain factor (MPAE)
56 H_DC_OFFSET	DC offset (MPAE)
57 H_FILTER_NAME	filter in use PDS <b>FILTER_NAME</b>
58 H_PIXEL_AVG_H	block height for pixel averaging prior to image compression PDS <b>PIXEL_AVERAGING_HEIGHT</b>
59 H_PIXEL_AVG_W	block width for pixel averaging prior to image compression PDS <b>PIXEL_AVERAGING_WIDTH</b>
60 H_TIMING_GEN	timing generator code (MPAE)
61 H_CAMERA	BB/EM/FM model (MPAE)
62 H_VACUUM	vacuum or not (yes or no) (MPAE)
63 H_OPTICS	additional optics on bench (MPAE)

IMPSOFT LABEL Item & Name	Description and/or FSW Structure Element (PDS keyword in <b>boldface</b> )
64 H_TESTLAMP	external test lamp (MPAE)
65 H_SHUT_TIME	opening time of CCD test shutter (MPAE)
66 H_LED_TIME	LED on time (MPAE)
67 H_SC_LAT	Latitude on target body at which the spacecraft rests PDS <b>SPACECRAFT_LATITUDE</b>
68 H_SC_LON	Longitude on target body at which the spacecraft rests PDS <b>SPACECRAFT_LONGITUDE</b>
69 H_SPIKE_CORRECT	
70 H_DARK_CORRECT	dark correction flag PDS <b>DARK_CURRENT_CORRECTION_FLAG</b>
71 H_FLAT_CORRECT	flat field correction flag PDS <b>FLAT_FIELD_CORRECTION_FLAG</b>
72 H_BADPIX_CORRECT	bad pixel correction flag PDS <b>BAD_PIXEL_REPLACEMENT_FLAG</b>
73 H_SHUTTER_CORRE	shutter effect correction flag PDS <b>SHUTTER_EFFECT_CORRECTION_FLAG</b>
74 H_IMAGE_MIN	Minimum pixel value on the image telem->min_val (only if doing sqrt compression) PDS <b>SQRT_MINIMUM_PIXEL_VALUE</b>
75 H_IMAGE_MAX	Maximum pixel value on the image telem->max_val (only if doing sqrt compression) PDS <b>SQRT_MAXIMUM_PIXEL_VALUE</b>
76 H_RICE_BLOCK	Block size for Rice compression telem->block PDS <b>INSTRUMENT_COMPRESSION_BLK_SIZE</b> (for RICE only)
77 H_RICE_OPTION	Start option for Rice compression telem->cmpr_data_1 PDS <b>RICE_START_OPTION</b>
78 H_RICE_NUMBER	Number of options in Rice compression telem->cmpr_data_2 PDS <b>RICE_NUMBER_OF_OPTIONS</b>
79 H_SYNC_INTERVAL	Compression synchronization interval telem->sync PDS <b>SYNCHRONIZATION_INTERVAL</b>

IMPSOFT LABEL Item & Name	Description and/or FSW Structure Element (PDS keyword in <b>boldface</b> )
80 H_GSE_REV	GSE revision creating data set
81 H_CONFIG_FILE	configuration file associated with data set
82 H_TEST_LOG	test log filename generating data
83 H_REC_BEG	first record of this data set in test log
84 H_REC_END	last record of this data set in test log
85 H_PIXEL_UNITS	units of pixels
86 H_SET_ID	data set id <b>PDS DATA_SET_ID</b>
87 H_SET_NUMBER	sequential number of this data set telem->image_id (cmd->image_id)
88 H_MISSION_TIME	mission time in seconds <b>PDS SPACECRAFT_CLOCK_START_COUNT</b>
89 H_CYCLE_NUMBER	sequential number of cycles
90 H_CYCLE_TYPE	cycle type
91 H_SOLAR_AZIMUTH	sun azimuth (degrees) <b>PDS SOLAR_AZIMUTH</b>
92 H_SOLAR_ELEV	sun elevation (degrees) <b>PDS SOLAR_ELEVATION</b>
93 H_NORTH_AZIMUTH	Angle between north pole and image center
94 H_IR_MEAS	number of IR sets performed during cycle
95 H_VIOLET_MEAS	number of violet sets performed during cycle
96 H_AZIMUTH	camera azimuth (degrees) relative to IMP frame base <b>PDS AZIMUTH</b>
97 H_ELEVATION	camera elevation (degrees) relative to IMP frame base <b>PDS ELEVATION</b>
98 H_AZIMUTH_FOV	azimuth field-of-view of scene (degrees) <b>PDS AZIMUTHAL_FIELD_OF_VIEW</b>
99 H_ELEVATION_FOV	elevation field-of-view of image (degrees) <b>PDS ELEVATIONAL_FIELD_OF_VIEW</b>
100 H_FOCAL_LENGTH	Camera focal length (mm)

IMPSOFT LABEL Item & Name	Description and/or FSW Structure Element (PDS keyword in <b>boldface</b> )
101 H_PIXEL_HEIGHT	height of a pixel (microns) PDS <b>PIXEL_HEIGHT</b>
102 H_PIXEL_WIDTH	width of a pixel (microns) PDS <b>PIXEL_WIDTH</b>
103 H_COMP_TIME	DCT compression time (seconds)
104 H_COMP_RECORD	DCT compression records
105 H_PACKET_ID	JPL telemetry packet id cmd ->packet_id PDS <b>APPLICATION_PACKET_IDENTIFICATION</b>
106 H_PACKETS_SENT	number of packets expected in image telem->of_total PDS <b>EXPECTED_PACKETS</b>
107 H_PACKETS_RCVD	number of packets actually received bce packet count PDS <b>RECEIVED_PACKETS</b>
108 H_DEPLOY_STATE	PDS deploy state
109 H_PARAMETER_TBL	
110 H_FLAT_FIELD_TBL	
111 H_BADPIXEL_TBL	
112 H_DARKCURRENT_I	
113 H_MFX_FRAME_AZ	camera azimuth measured in the Mars Surface Fixed frame (MFX frame) PDS <b>SURFACE_BASED_CAMERA_AZIMUTH</b>

IMPSOFT LABEL Item & Name	Description and/or FSW Structure Element (PDS keyword in <b>boldface</b> )
114 H_MFX_FRAME_EL	camera elevation measured in the Mars Surface Fixed frame (MFX frame) <b>PDS SURFACE_BASED_CAMERA_ELEVATION</b>
115 H_COMP_ACTUAL	<b>PDS INS_COMP_RATIO</b>
116 H_MOSAIC_LINE	mosaic pointing reference line <b>PDS MOSAIC_REFERENCE_LINE</b>
117 H_MOSAIC_SAMPLE	mosaic pointing reference sample <b>PDS MOSAIC_REFERENCE_SAMPLE</b>
118 H_MOSAIC_AZIMUT	recomputed camera azimuth of mosaic <b>PDS MOSAIC_REFERENCE_AZIMUTH</b>
119 H_MOSAIC_ELEV	recomputed camera elevation of mosaic <b>PDS MOSAIC_REFERENCE_ELEVATION</b>
120 H_PROJECTION	projection type of map <b>PDS MAP_PROJECTION_TYPE</b>
121 H_ORIENTATION	mosaic orientation relative to North pole <b>PDS ORIENTATION</b>
122 H_RESOLUTION	mosaic resolution <b>PDS MOSAIC_RESOLUTION</b>
123 H_RADIAL_RES	pixels per degree at nadir point in mosaic <b>PDS RADIAL_MOSAIC_RESOLUTION</b>
124 H_FIRST_AZIMUTH	
125 H_ZERO_ELEV	image line for zero elevation <b>PDS ZERO_ELEVATION_IMAGE_LINE</b>
126 H_NADIR_LINE	image line where nadir projects <b>PDS NADIR_LINE</b>
127 H_NADIR_SAMPLE	image sample where nadir projects <b>PDS NADIR_SAMPLE</b>
128 H_CAL_TMP_SORS	cal. source voltage
129 H_CCDLUG_TEMP	CCD thermal lug temperature [K]
130 H_COORD_TYPE	coordinate system used in image request cmd->coor_type
131 H_DIRECTION_VEC	camera pointing direction vector cmd { x_az, y_el, z_z } iff coor_type == COOR_UNIT_VEC

IMPSOFT LABEL Item & Name	Description and/or FSW Structure Element (PDS keyword in <b>boldface</b> )
<b>PDS POINTING_DIRECTION_VECTOR</b>	
132 H_DIR_Y	camera pointing, y component of vector cmd { x_az, y_el, z_z } iff coor_type == COOR_UNIT_VEC
133 H_DIR_Z	camera pointing, z component of vector cmd { x_az, y_el, z_z } iff coor_type == COOR_UNIT_VEC
134 H_L_FRAME_AZ	camera azimuth measured in the Lander frame <b>PDS LANDER_FRAME_CAMERA_AZIMUTH</b>
135 H_L_FRAME_EL	camera elevation measured in the Lander frame <b>PDS LANDER_FRAME_CAMERA_ELEVATION</b>
136 H_AUX_BRD_VOLT	divided 12V in volts
137 H_CPU_BRD_VOLT	divided 5V in volts
138 H_ADC_OFFSET	0V input; ADC offset
139 H_ADC_GAIN	2.5 input; gain of ADC
/* Calibration Header Fields */	
140 H_TEST_TYPE	calibration test type string bce: ?
141 H_TARGET_DISTAN	calibration distance to target (cm) float bce: ?
142 H_SERIES	calibration LSF/MSF Series string bce: ?
143 H_ENV_CHAMBER	calibration environmental chamber string bce: ?
144 H_CAL_CCD_TEMP	calibration external ccd temperature [K] bce: ?
145 H_BASEPLATE_TEMP	calibration baseplate temperature [K] float bce: ?
146 H_PRESSURE	calibration pressure (Torr) float bce: ?

IMPSOFT LABEL Item & Name	Description and/or FSW Structure Element (PDS keyword in <b>boldface</b> )
147 H_STAGE_POSITN	calibration linear stage position (mm) float bce: ?
148 H_STAGE_ROT	calibration rotary stage position (degrees) float bce: ?
149 H_TARGET_TYPE	calibration target type string bce: ?
150 H_MONO_WAVELEN	calibration monochromometer wavelength (nm) float bce: ?
151 H_MONO_BANDWID	calibration monochromometer bandwidth (nm) float bce: ?
152 H_STD_DETECTOR	calibration standard detector float bce: ?
153 H_POLARIZATION	calibration polarization angle (degrees) float bce: ?
154 H_SLIT_WIDTH	calibration slit width (mm) float bce: ?
155 H_HW_MODEL	hardware model (flight, proto, engineer)
156 H_NUM_BINS	number of IR bins for data collection
157 H_SURF_LAMP_REP	surface lamp rep. number
158 H_SUN_LAMP_REP	sun sensor LED rep. number
159 H_CAL1_VOLT1	voltage on cal. lamp 1
160 H_QUATERNION	camera orientation quaternion (first array element) <b>PDS CAMERA_ORIENTATION_QUATERNION</b>
161 H_Q_Y	second array element of quaterion <b>PDS CAMERA_ORIENTATION_QUATERNION</b>
162 H_Q_Z	third array element of quaterion <b>PDS CAMERA_ORIENTATION_QUATERNION</b>



IMPSOFT LABEL Item & Name	Description and/or FSW Structure Element (PDS keyword in <b>boldface</b> )
163 H_Q_W	fourth array element of quaterion PDS <b>CAMERA_ORIENTATION_QUATERNION</b>
164 H_FOCAL_VECTOR	camera model focal center position (first element of vector) PDS <b>FOCAL_CENTER_VECTOR_C</b>
165 H_F_Y	second element of focal center vector PDS <b>FOCAL_CENTER_VECTOR_C</b>
166 H_F_Z	third element of focal center vector PDS <b>FOCAL_CENTER_VECTOR_C</b>
167 H_HORIZONTAL_V	image plane horizontal direction vector (first element of vector) PDS <b>HORIZONTAL_IMAGE_PLANE_VECTOR_H</b>
168 H_H_Y	second element of horizontal direction vector PDS <b>HORIZONTAL_IMAGE_PLANE_VECTOR_H</b>
169 H_H_Z	third element of horizontal direction vector PDS <b>HORIZONTAL_IMAGE_PLANE_VECTOR_H</b>
170 H_VERTICAL_VEC	image plane vertical direction vector (first element of vector) PDS <b>VERTICAL_IMAGE_PLANE_VECTOR_V</b>
171 H_V_Y	image plane vertical direction vector (second element of vector) PDS <b>VERTICAL_IMAGE_PLANE_VECTOR_V</b>
172 H_V_Z	image plane vertical direction vector (third element of vector) PDS <b>VERTICAL_IMAGE_PLANE_VECTOR_V</b>
173 H_NUM_HEAT	number of heaters tested
174 H_NUM_TRIPLET	number of sun triplets in data set
175 H_NUM_TIME_PAIRS	number of time data pairs
176 H_DUMP_START	address of first word in dump
177 H_DUMP_LEN	number of words in dump set
178 H_DUMP_FLAG	packing flag
179 H_MESSAGE	message type code
180 H_MESSAGE_ID	additional information code
181 H_NUM_BAD	number of bad ranges in RAM or EEPROM
182 H_LOTS_BAD	flag - lots bad RAM or EEPROM areas

IMPSOFT LABEL Item & Name	Description and/or FSW Structure Element (PDS keyword in <b>boldface</b> )
183 H_CCDTEMP_R	raw CCD temperature telem->ccd_temperature <b>PDS SENSOR_TEMPERATURE</b>
184 H_EXPTIME_R	raw exposure time reading telem-> integration_time (cmd->integration_time) <b>PDS EXPOSURE_DURATION</b>
185 H_MISSION_TIME_R	raw mission time reading telem -> image_time <b>PDS SPACECRAFT_CLOCK_START_COUNT</b>
186 H_AZIMUTH_R	raw azimuth reading cmd->azimuth (telem->azimuth) <b>PDS AZIMUTHAL_MOTOR_CLICKS</b>
187 H_ELEVATION_R	raw elevation counts cmd->elevation (telem->elevation) <b>PDS ELEVATIONAL_MOTOR_CLICKS</b>
188 H_SPIN_R	raw spin rate reading
189 H_TARGET_AZ_R	raw target azimuth
190 H_ACTUAL_AZ_R	raw actual azimuth
191 H_IR_CHP_TMPB_R	raw IR chip temperature start
192 H_IR_CHP_TMPE_R	raw IR chip temperature end
193 H_PRECHARGE_R	raw average precharge voltage
194 H_IR_COL_TIME_R	raw IR collection time used
195 H_CAL_TMP_SORS_R	raw cal. source voltage
196 H_CCDLUG_TEMP_R	raw CCD thermal lug temperature
197 H_STRAP_TEMP_R	raw strap temperature
198 H_OPTICS_TEMP_R	raw conduit temperature
199 H_VIOLET_TEMP_R	raw violet temperature
200 H_SH_AUX_TEMP_R	raw SH aux board temp
201 H_SH_BOX_TEMP_R	raw SH box temperature
202 H_EA_BOX_TEMP_R	raw EA box temperature

IMPSOFT LABEL Item & Name	Description and/or FSW Structure Element (PDS keyword in <b>boldface</b> )
203 H_AUX_BRD_VOLT_R	raw divided 12V
204 H_CPU_BRD_VOLT_R	raw divided 5V
205 H_ADC_OFFSET_R	raw 0V input
206 H_ADC_GAIN_R	raw 2.5V input
207 H_CAL1_VOLT1_R	raw cal. lamp 1 voltage
208 H_CAL1_VOLT2_R	raw cal. lamp 1 voltage
209 H_CAL2_VOLT1_R	raw cal. lamp 2 voltage
210 H_CAL2_VOLT2_R	raw cal. lamp 2 voltage
211 H_CAL3_VOLT1_R	raw cal. lamp 3 voltage
212 H_CAL3_VOLT2_R	raw cal. lamp 3 voltage
213 H_SURF_VOLT1_R	raw surf. lamp voltage
214 H_SURF_VOLT2_R	raw surf. lamp voltage
215 H_SUN_LED_VLT1_R	raw sun sensor LED volt
216 H_SUN_LED_VLT2_R	raw sun sensor LED volt
217 H_OBJECTIVE	objective of test
218 H_DUMMY	flag for dummy detector
219 H_MODEL	DISR model for MMC
220 H_DCOFFSETU_R	raw ADC value of DC offset voltage, ULIS
221 H_DCOFFSETD_R	raw ADC value of DC offset voltage, DLIS
222 H_IMP_FRM_ORG_X	X offset in meters from the Mars Surface Fixed Frame (MFX frame) to the origin of the IMP Frame. <b>PDS IMAGE_FRAME_ORIGIN</b>
223 H_IMP_FRM_ORG_Y	Y offset in meters from the Mars Surface Fixed Frame (MFX frame) to the origin of the IMP Frame. <b>PDS IMAGE_FRAME_ORIGIN</b>
224 H_IMP_FRM_ORG_Z	Z offset in meters from the Mars Surface Fixed Frame (MFX frame) to the origin of the IMP Frame. <b>PDS IMAGE_FRAME_ORIGIN</b>

IMPSOFT LABEL Item & Name	Description and/or FSW Structure Element (PDS keyword in <b>boldface</b> )
225 H_SUN_SOURCE	source of spin data
226 H_OGSE_STATUS	status of OGSE
227 H_OGSE_MSG	last msg from EGSE displayed on OGSE
228 H_OGSE_LAMP	lamp current
229 H_OGSE_SUNFILE1	path of sun pulse file
230 H_OGSE_SUNFILE2	path of sun pulse file
231 H_OGSE_SAMP	sun amplitude current
232 H_OGSE_SUNTABLE	sun table
233 H_OGSE_RPM	sun pulse RPM
234 H_OGSE_SPAN	sun pulse span value
235 H_OGSE_SIDEDEC	Si detector reference
236 H_OGSE_GEDEC	Ge detector reference
237 H_OGSE_EXTDEC	external detector reference
238 H_OGSE_5V	5V reference
239 H_OGSE_TEMP	internal temperature
240 H_OGSE_SSS_TEMP	sun sensor stimulator temp.
241 H_OGSE_GN	analog ground noise
242 H_TELEM_SOFT	<b>PDS SOFTWARE_VERSION_ID</b>
243 H_IMAGE_TYPE	Image data type as specified in the image packet (regular image, dark current, flat field, etc.) <b>PDS IMAGE_OBSERVATION_TYPE</b>
244 through 252	<i>(not used)</i>